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A net-zero framework for farms: a business plan

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A Net-Zero Framework for Farms: A Business Plan

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Abstract

With current agricultural methods causing an abundance of environmental problems, LDEC, LLC is an environmental consulting firm created to address these environmental impacts in the Southeast region of the United States. Examining an industry overview of small dairy farming (a dairy farm having fewer than 500 cows) in the state of Tennessee, LDEC, LLC looks to potentially impact the farming industry on a larger scale. The research for LDEC, LLC is centered on utilizing net-zero technologies in order to address energy usage, water consumption, and waste build-up on farms and reduce their side effects. The success of net-zero initiatives in office and residential settings provides a positive outlook for the use of these systems on farms, but the cost to implement net-zero technologies may not be economical for small farmers. By examining the current status of the dairy industry throughout the United States and Tennessee, LDEC, LLC is able to begin determining if net-zero initiatives are transferable to a farming environment.

ENVIRONMENTAL
CONSULTING

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Executive Summary

Our Mission

LDEC, LLC is an environmental consulting firm and project management company that provides expertise, knowledge, and guidance towards net-zero initiatives beginning with small Tennessee dairy farms having fewer than 500 cows. The value proposition LDEC, LLC delivers is guidance towards self-sufficiency on farms while not only providing efficiency and long-term cost-cutting methods to production but also providing environmentally friendly practices.

Company and Management

LDEC, LLC is a privately held limited liability company (LLC) in Loudon, Tennessee, with one owner and two starting employees who will all be managing members. These employees bring business related experience that is crucial to the development of new markets in the agriculture, environmental, and business realms. With the LLC being incorporated in Tennessee, this location offers the best conditions for logistic positioning. Loudon is within minutes of driving distance to Knoxville and a couple hours driving distance to Chattanooga and Nashville, while still being in a “farmland” area.

Services

LDEC, LLC’s main services revolve around farms who desire to save money or want to incorporate environmentally friendly practices within their daily operations. LDEC, LLC offers multiple services to assist farms in meeting these goals including

- Providing guidance on incorporating net-zero and sustainability initiatives
- Finding “green certifications” to boost brand values for LDEC, LLC customers (See *Appendix C*)
- Providing grant writing services to help secure funding
- Connecting farms with business sponsors and/or grants to assist in funding the projects
- Creating a supply chain that leverages eco-friendly practices and appeals to the “green” consumer preferences

Market Overview

Dairy Farming (Primary Market)

With milk declared as a staple food by the U.S. Department of Agriculture, demand and revenue for milk and milk products are both expected to slightly increase over the next five year period (2018-2023) by .3 percent. Milk prices are expected to stabilize in this period after the 2.4 percent decline in the price from 2013 to 2018. Consolidation of farms is still progressing around 1.4 percent due to labor savings and lower overhead costs on larger farms, so the total number of dairy farms is declining. These trends hold

true in Tennessee as well. The Tennessee dairy market generates around $114.6 million dollars in revenue, and total milk production in Tennessee has increased to around $130,977,000. Demand for milk is dependent on the price of milk, population growth, health concerns, competition and substitutes, and innovation.

Environmental CSR in Corporations (Secondary Market)
Corporate Social Responsibility (CSR) efforts in businesses are more prominent and more important than ever before, especially environmental ones. Based on consumer preferences, businesses are shifting to include more CSR contributions in their budgets to work towards a stronger triple bottom line, so the spending on environmental CSR efforts is expected to increase. Demand for CSR assistance is reliant on consumer demands, government regulations, company profits, and company competition.

Competitive Advantages
The competitive advantages of using LDEC, LLC on farms include assistance in funding net-zero and sustainability projects, cost cutting techniques for farmers (see *Appendix B* for examples), green certification potential during or after net-zero implementation processes (see *Appendix C* for examples), grant writing services, agriculture specific consulting knowledge, and transition assistance to a more self-sufficient lifestyle.

Financial Projections

	Year 1	Year 2	Year 3
Revenues	$188,100	$308,100	$388,104
Expenses	$255,918	$251,585	$255,835
Operating Income	($67,818)	$56,515	$132,269

*These expenses include salaries

Start-Up Financing Requirements
Start-up expenses necessary for LDEC, LLC include rent, utilities, office furniture/supplies, marketing, website upkeep, LLC establishment fees, taxes, and insurance, averaging at a total cost of **$46,080.** This cost is based off of working in a storefront location in downtown Lenoir City in an 800 square foot office space. If LDEC, LLC starts in a “work from home” scenario instead of an office space right away, the total costs become **$32,280**. See section 7.2 for a breakdown of expected expenses/costs.

1.0 Introduction

Lauren Dunn Environmental Consulting (LDEC) is a startup limited liability company (LLC) based in Loudon, Tennessee. The company intends to assist farms with transitioning and incorporating environmental initiatives into daily operations in order to help farmers save money over time, and it will likely allow farmers to appeal more to large scale farming firms by providing farming practices in the supply chain that entice "green" customers. Our strategy is to leverage the use of net-zero sustainability techniques to ultimately transform small farms to self-sufficient living and independent entities to help improve small, independent farming in Tennessee.

Net-zero is an approach that takes sustainability techniques a step further and creates closed-loop systems for energy/carbon, water, and waste processes. Net-zero occurs when consumption of energy/carbon, water, or waste is less than or equal to the amounts produced by the renewable sources on-site on an annual basis. See explanations and definitions of the net-zero concepts in *Appendix A*, pages 43-51. Examples of net-zero systems and techniques are explained further in section 5.0B in this plan.

The most research and usage of net-zero initiatives today are found in residential housing and commercial office buildings; however, due to the success of these activities, farms are beginning to apply these techniques into their operations as well (See *Appendix B* for examples). The Brant Hutterite Colony in Alberta, Canada has a net-zero carbon egg farm. Wampler's Meat has a net-zero energy farm. Joseph Farm Cheese has a net-zero energy farm. Eminence Organic Farm in British Columbia, Canada, has a net-zero waste farm. Net-zero farms are out there across the globe and are gaining momentum. Green Business Insider (2019) claims that the United Kingdom is even calling for net-zero carbon on all farms by 2040 to "stay ahead of the competition in the market."

The purpose of starting LDEC, LLC is to help revolutionize small, independent farmers in order to save farmers money and gain more flexibility within the agriculture industry. The current state of the farming industry has the power in the hands of a few dominant agribusinesses in most farming sectors, including dairy. The bargaining power of agribusiness suppliers leaves small farmers at their mercy in terms of pricing, demand, and livelihood by having the ability to hire and fire small farmers at will with little retaliation. Due to the current status in farming, small farms are dying out and merging with large farms, increasing problems. Agribusinesses are successful at meeting or succeeding demand output because they employ small farms to assist them, so without small farmers, producing the output of food needed to feed a growing world population is becoming more difficult. The secondary purpose of LDEC, LLC is to address the detrimental, large scale environmental effects of industrial agriculture (see *Appendix A*, pages 51-56), with examples being soil quality, water pollution, excessive waste, and loss of biodiversity, among others. The solution LDEC, LLC is offering to fix these industry concerns is expanding guidance on net-zero initiatives to the farming world that have proved successful in office and residential spaces. This plan is looking at the

feasibility of net-zero initiatives in a farm setting and will discuss the idea from a business standpoint.

Net-zero in a farming context is an up and coming operation on a global scale. Farms in Europe are already deciphering how net-zero ideas can be framed within agriculture to use this as an approach to more sustainable farming methods. There is potential for net-zero to become an efficient farming method in itself to help save small farms.

This company plans to start with small size Tennessee dairy farms, dairy farms containing fewer than 500 cows, before expanding to regional coverage as well as expanding to other sectors within the farming industry such as additional livestock or crops. The demand for environmental stewardship is increasing as is the need for small farm assistance to avoid buy-outs or acquisitions by large, industrial farms and to keep money in local economies to support small scale farmers and communities (see *Appendix A*, pages 46-49, for more elaboration).

There are many monetary incentives for farmers to begin switching to alternative energy sources. The Business Energy Investment Tax Credit is an incentive farmers need to be informed of because it provides a 30 percent tax credit for solar, fuel cells, and wind as well as a 10 percent tax credit for geothermal, micro-turbines, and combined heat and power systems. The solar technologies included in this credit are defined by the Environmental Protection Agency (EPA) as,

> *"Eligible solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. Hybrid solar lighting systems, which use solar energy to illuminate the inside of a structure using fiber-optic distributed sunlight, are eligible. Passive solar systems and solar pool-heating systems are not eligible."*

The Energy-Efficient Commercial Buildings Tax Deduction could also be useful for dairy farms in their dairy milking facilities. This tax deduction allows one to save $.30 to $1.80 per square foot, depending on the amount of energy reduction and the technology used. Some examples of eligible technologies include water heaters, air conditioners, windows, duct/air sealing, and caulking. The Sales Tax Credit for Clean Energy Technology is another financial aid in net-zero processes. This financial incentive grants a sales tax exemption. However, this provides the contractor used for installation of geothermal electric, biomass, wind, and solar photovoltaics and the taxpayer who hired the contract to submit applications for approval.

In terms of the Environmental Protection Agency, the United States is in the early stages of a monumental shift towards renewable energy initiatives and addressing climate change. Industrial farming and agribusinesses in the U.S. are at the top of the polluting industry list contributing anywhere from 18 percent (production only) to 50 percent (production, packaging, and transportation). Assisting small farms in shifting to environmentally friendly practices gives them a competitive advantage to tap into a

“green” customer base and to showcase a greener supply chain, which in turn can capture some market share and bring in more revenues (see Appendix A, pages 49-53, for more information on current farming issues). Few small farms in Tennessee have taken advantage of the tax incentives offered because they either do not have the necessary equipment to quality, or they are simply unaware of the advantages. Small farms also provide another market for the solar industry, which factors into the U.S. alternative energy research.

Overall, there has been a rapid decline in the Tennessee dairy industry over the last couple decades because of corporate farming takeovers; yet this decline provides an opportunity to “revamp” the dairy sector of Tennessee agriculture since Tennessee dairy yields are expected to increase between 2018 and 2023, and Tennessee dairy farmers are exploring all options to help keep their dairies in business. The decrease in the total number of farms provides LDEC, LLC the opportunity to try new operational methods that would provide new outlets for sales, connect farmers to their communities, connect communities to their farmers, boost the local economy, and appeal to the upcoming generation of farmers.

The primary target markets LDEC, LLC is looking at include the small size dairy farms of Tennessee, small Tennessee farms in the crop or other livestock sectors, and small farms in the Southeast region of the United States. Furthermore, LDEC, LLC seeks to target businesses in areas surrounding the farm clients as a secondary market by capitalizing on companies’ expansions of environmental corporate responsibility (CSR) efforts by connecting companies to local farms in the form of a sponsor or outreach program. Preliminary market research displays a need for environmental initiatives (see *Appendix A*, pages 49-53) and portrays an increase in CSR efforts, with small farms reacting positively to the implementations.

Our value propositions to target customers are as follows:

- Readily available services for consultation
- Connections to funding
- Expertise and knowledge of the relationship between net-zero initiatives and agriculture
- A detailed plan of implementation of net-zero projects over time with costs and return on investment values projected
- Reduction in personal operation costs
- Reduction in harmful environmental effects

- Certification highlighting “green” production methods and efforts to boost brand to consumers
- Grant-writing services
- Tax credit incentives

1.1 Objectives

The objectives of LDEC, LLC are to:

- Provide our customers with a consistent and reliable supply of water and energy by transitioning them to self-sufficiency in the form of net-zero initiatives.
- Provide environmentally friendly alternatives for daily operations to lessen a farm’s carbon footprint (See *Appendix A*, pages 49-53).
- Demonstrate that net-zero initiatives are a worthy investment for farmers, local communities, and the environment by minimizing costs, increasing operational efficiencies, and decreasing negative environmental impacts. See *Appendix B* for examples.
- Provide an outlet for cost-cutting to cushion fixed costs. See *Appendix B* for examples.
- Move the target market segment toward a reduction of dependence on government subsidies to be profitable or to stay functioning.
- Move our customers toward “greening” practices and operations to be at an advantageous stage if the EPA or government laws change quickly.

- ❖ Find “green certifications” to boost brand values for LDEC, LLC customers that are working toward and/or have completed the net-zero implementation phases. See *Appendix C* for list of green certification possibilities.
- ❖ Connect farms with business sponsors and/or grants to assist in funding or fully funding the transition process.
- ❖ Utilize community connections to increase agriculture education and implement sustainable development initiatives.
- ❖ Create a supply chain that leverages eco-friendly practices and appeals to the “green” consumer preferences.
- ❖ Give guidance on how to acquire and qualify for tax incentives.

1.2 Mission

LDEC, LLC is an environmental consulting firm and project management company that seeks to provide expertise, knowledge, and guidance towards net-zero initiatives beginning with small Tennessee dairy farms, fewer than 500 cows, and energy savings. The company offers environmental consulting at a cost comparable to other firms, but it focuses specifically on agriculture and farming institutions. The value proposition LDEC, LLC delivers is guidance towards self-sufficiency on farms while not only providing efficiency and cost-cutting methods to production but also providing environmentally friendly practices. These practices work towards eight of the United Nations’ Sustainable Development Goals including good health and well-being; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; sustainable cities and communities; responsible consumption and production; and climate action. LDEC, LLC aspires to work towards the United Nations’ development goals in the Southeast region of the U.S. by connecting businesses and surrounding communities to agriculture and by promoting education of farming and sustainable development.

1.3 Keys to Success

According to IBIS world, the keys to success in the environmental consulting industry include

- “**Ability to compete on tender:** It is important that companies in this industry compete profitably for tendered contracts.
- **Effective cost controls:** Since wages make up a large portion of the industry's costs, companies must ensure that effective cost-control systems are in place.
- **Access to multi-skilled and flexible workforce:** Companies should have qualified staff who are knowledgeable about a wide range of industries.
- **Ability to negotiate successfully with regulator:** Successfully obtaining government contracts and references gives consultants access to more business.
- **Fast adjustments made to changing regulations:** The industry generates an increasing amount of revenue by reacting to new regulations and assisting businesses through new environmental landscapes.
- **Well-developed internal processes:** Given the generally labor-intensive nature of the industry, operators need to ensure that appropriate cost- and time-management systems are in place on a project basis so that these can be closely monitored.
- **Access to highly skilled workforce:** Often, consulting contracts are entered into on the basis of the consultant possessing specialized knowledge that relates to clients' operations. Without this skill base, the consulting firm has little bargaining power. See section 6.0 for elaboration on skills needed.

- **Access to niche markets:** Firms can be more successful if they have specialized skills or services and can serve a niche market.
- **Having good working relationships with subcontracting building trade specialists:** Subcontractors are used to ensure that quality output can be guaranteed on time and budget. Many skilled consultants operate as independent contractors."

2.0 Company Summary

LDEC, LLC is a startup firm managed by one executive representing all administrative roles within the organization known as the "Environmental Manager". There will be additional employment positions added including, but not limited to, a system designer (e.g. engineer or architect) known as the "Director of Design" and a marketing representative known as the "Director of Marketing". These employees bring business related experience that is crucial to the development of new markets in the agriculture, environmental, and business realms. The group will understand the market, expectations, and goals of the company and the importance of incorporating net-zero initiatives as well as environmental CSR efforts. The company is organized as a limited liability company with all the shares currently held by the founding executive. With the LLC being incorporated in Tennessee, this location offers the best conditions for incentives and logistic positioning for addressing the environmental concerns within the state itself due to its location in Loudon and distance from three of the largest cities within the state (Knoxville, Chattanooga, and Nashville), while still being in a "farmland" area. Furthermore, Loudon is the top milk producing county in the state.

2.1 Company Ownership

LDEC, LLC is a privately held limited liability company in Loudon, Tennessee, with one owner and two starting employees who will all be managing members. The owner is Lauren Dunn.

3.0 Overall Primary and Secondary Market Analysis

Dairy Farming (Primary Market)
The dairy farm industry is tied with the dairy product production industry. The industry includes "only the sale of raw milk and excludes the production of drinkable fluid milk

and processed dairy products like butter, cheese and powdered milk." All value-added activities are considered dairy product production.

With milk declared as a staple food by the U.S. Department of Agriculture, demand and revenue for milk and milk products are both expected to slightly increase over the next five year period (2018-2023) by .3 percent. Milk prices are expected to stabilize in this period after the 2.4 percent decline in the price between 2013-2018. Consolidation of farms is still progressing around 1.4 percent due to labor savings and lower overhead costs on larger farms, so the total number of dairy farms is declining. These trends hold true in Tennessee as well. The Tennessee dairy market generates around $114.6 million dollars in revenue, and total milk production has increased to around $131.0 million dollars. Demand for milk is dependent on the price of milk, population growth, health concerns, competition and substitutes, and innovation.

Environmental CSR in Corporations (Secondary Market)
Corporate Social Responsibility (CSR) efforts in businesses are more prominent and more important than ever before, especially environmental ones. The World Business Council defines CSR as, "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large."

The U.S. attitude of CSR in business operations stems from a mindset of making profit, paying taxes, and donating money to charitable contributions to improve company image. Based on consumer preferences, businesses are shifting to include more CSR contributions in their budgets to work towards a stronger triple bottom line. Demand for CSR investment is reliant on consumer demands, government regulations, company profits, and company's competition.

3.1 Factors Creating the Market for Environmental Consulting in Farming

The government is arguably the main driver for environmental initiatives on farms due to regulations enacted and tax incentives offered. The growth in the industry is largely driven by government policies, technological advances, and changing perceptions that support energy efficiency. IBIS World explains,

> *"Environmental protection legislation and regulation increase industry demand, as environmental consultants are needed to help companies and other entities comply with this legislation. Environmental protection legislation and regulation are projected to increase."*

With reduction of greenhouse gas emissions as a worldwide goal, all industries are striving to remain ahead of regulatory changes. Companies in high polluting sectors are also feeling the pressures of remaining ahead of forced government actions, so they are

also attempting to transition to a more environmentally friendly image. In addition, alternative energy sources are becoming a national security concern, which has been increasing the use of solar panels as a result of their decreasing costs as a source of alternative energy. Retrospectively, tax credits are given from the government to anyone willing to switch to alternative energy sources and, thus, are causing a higher demand for environmental consulting services. The higher tax credits present more reasons to incorporate energy efficient practices while raising a greater demand from consultants to analyze and implement solutions. New environmental legislation will be a main driver for environmental efforts.

Laws already enforced by the Environmental Protection Agency (EPA) include the Clean Air Act (CAA), the National Emissions Standards for Hazardous Air Pollutants (NESHAP), and the National Pollutant Discharge Elimination System (NPDES): Animal Feeding Operations (AFOs) help regulate the negative health effects on individuals as well as the environment from farming practices.

Some agricultural areas are also impacted by ozone National Ambient Air Quality Standards (NAAQS) which mainly deal with nitrogen oxides and Volatile Organic Compound (VOC) emissions. Nitrogen oxides and VOCs impact animal production and pesticide application practices, which is why they are regulated by the CAA.

The NESHAP law mentioned previously is explained by the EPA as follows:

> *"The intent of these standards is to reduce emissions of hazardous air pollutants (HAP) from existing and new facilities that manufacture organic pesticide active ingredients (PAI) used in herbicides, insecticides, and fungicides.*
> *The major HAP emitted by these facilities include toluene, methanol, methyl chloride, and hydrogen chloride (HCl). All of these pollutants can cause reversible or irreversible toxic effects following exposure."*

Lastly, the NPDES addresses the potential for manure and wastewater to contribute pollutants including phosphorus and nitrogen, sediments, pathogens, hormones, antibiotics, and organic matter into the environment.

These laws draw attention to farm regulations in order to limit detrimental health effects to surrounding communities from agriculture practices. These laws along with other demand determinants such as milk prices, per capita milk consumption, milk demand, price of operating costs, tax credit incentives, and lower price of solar panels drive the market for environmental consulting within the agriculture industry.

3.2 Changes in the Markets

Dairy
Between 2013 and 2018, the demand for milk has been on the decline by 2.4 percent. In Tennessee, dairy farming has dropped to only 224 remaining small dairy farms. Milk prices are expected to decrease, which means the revenue for farmers is lower; however, the demand for milk products is slowly rising for the 2018-2023 period at .3 percent, potentially increasing revenues. More consolidation of farms is likely to take place at this rate because larger farms (i.e. industrial farms/agribusinesses) have the ability to lower operating costs.

Environmental Consulting
In terms of the environmental consulting industry, government spending on services has become stagnant, which hurts the industry overall since the government is the largest sector of funding for consulting services at 19.6 percent. However, the changes in public attitude as well as the passage of more environmental laws have increased the demand for environmental consultants, boosting the industry. Despite the slowdown in government spending towards the industry, the remaining 80.4 percent of the industry is progressing well. Organizations continually hire consultants to ensure compliance with current and new regulations. The Energy Policy Act (2005) and the Energy Independence and Security Act (2007) still play a crucial role in the industry today:

> *"These laws aim to increase the production of renewable fuels; raise investment in the sustainability of products, buildings and vehicles; and promote research on renewable technologies and US energy security...The laws will still influence the industry in 2018, as the federal government and private businesses strive to achieve their goals."*

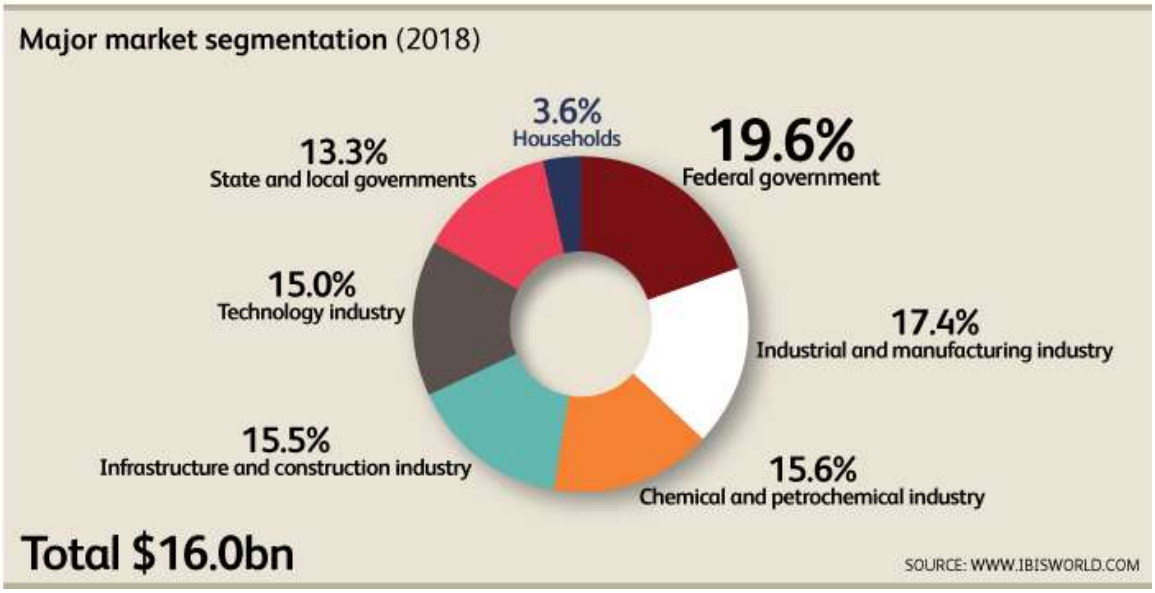
Corporations heavily influence the environmental consulting industry due to their availability of disposable profits and investment in company image. A business' reputation sways the use of environmental consulting firms since consumer preferences are geared towards environmentally aware companies. Furthermore, corporations generally have more profits and money to spend on endeavors outside operations. The next five years foresee growth in company spending on environmental practices on an internal and external level.

Solar
The solar installation industry is influential for LDEC, LLC's success because it is where LDEC, LLC wants to start its net-zero implementation phases. With the U.S. encouraging spending and research on alternative energy technologies, solar energy is a promising path to net-zero energy functions and is an easy starting point for net-zero transformation. The Energy Policy Act (2005) gives a 30 percent tax credit for commercial and residential solar power systems, and it provides a 25 percent rebate on qualifying equipment (or $3,000, whichever is less). These incentives partnered with lowering installation costs leave solar installations increasing from 2018 to 2023 at a projected 10.4 percent. Technology advances will also aid in lowering solar panel costs

and driving revenue as will the surge in electricity usage over the next five years. However, a recent 30 percent tariff on solar imports causes concerns to pricing, for inexpensive imports helped keep the cost low.

Natural gas is a competitor to solar energy due to its “clean reputation” and low pricing, so this has an effect on solar energy pricing. Nonetheless, the price of natural gas is expected to rise yearly at 1.4 percent, making solar alternatives a more attractive investment for consumers looking to switch away from coal to a more sustainable substitute.

3.3 Market Segments



Over half (63.5 percent) of the consulting firms in the United States generate revenue from the private business sector. The industry’s largest clientele segments come from the government and manufacturing, construction, and energy generation industries because they are ensuring federal regulations are met. The agriculture industry is not a major player for environmental consulting leaving a new market gap potential. The net-zero idea on small farms can touch multiple major segments including households (extending farm initiatives to a farmer’s place of residence), infrastructure and construction (building the net-zero systems), and industrial (working with small farms that supply industrial ones). Furthermore, only 7.9 percent of consultants are deemed “specialized environmental consulting services”, meaning this segment includes specialized services pertaining to environmental economic consulting; agricultural, fisheries and biological consulting; energy, mining, geological and geophysical consulting; occupational health and safety consulting. Demand from this segment has expanded over the past five years as higher economic output from these industries has increased environmental requirements. With that being said, there are low competitors

for entry as compared to other product and service segments playing into a particular market that is one of LDEC, LLC's keys to success due to special services and skills.

With 46.8 percent of dairy farmers not in the Great-Lake or Western regions of the U.S., there is potential for Southeastern regional expansion as planned since about 19 percent of dairy farmers are in LDEC, LLC's five states of interest. Expansion is encouraged because less than 3 percent of dairy locations (224 total farms) are in Tennessee, but this provides a niche market to start out. There are approximately 36,000 dairy cows in the state of Tennessee, with the average herd consisting of around 140 cows. An approximate number of small dairy farms, 500 cows or fewer, by select southern states are as followed:

Tennessee	224
Georgia	172
Alabama	35
North Carolina	145
South Carolina	175

3.4 Target Markets and Customer Characteristics

Our primary target market is the small dairy farm industry in the state of Tennessee. A small dairy farm is defined as having fewer than 500 cows used for milk production. This market has begun transitioning toward sustainability efforts by beginning to increase use of solar energy alternatives, aquaponic technologies, organic methods of production, natural animal raising, natural pest management, and manure control, but net-zero initiatives would be another step forward.

There is a large gap in this area for environmental efforts because the transition towards environmentally friendly practices is still at the forefront, and net-zero strategies are still being understood in office and residential contexts and have yet to break far into the farming industry. LDEC, LLC's beginning primary target market includes the 224 small dairy farms in Tennessee.

LDEC, LLC's secondary market is for businesses in surrounding areas who want to invest in environmental CSR endeavors. Because the private business sector is a substantial contributor to environmental consulting revenue, LDEC, LLC wants to tap into that market by connecting businesses with environmental CSR goals to local farms in the form of sponsorship support; in return, the company receives discounted consulting through LDEC, LLC. The dollar amount allocated to CSR spending in corporations is on the rise and is expected to continue increasing over the next five year

period (2018-2023). CSR and community outreach are becoming a normalized and expected practice within corporations as a response to consumer demands and preferences.

In terms of customer characteristics, the two target markets start off with Tennessee dairy farms with fewer than 500 cows that have a desire to continue or to start environmentally friendly practices on these farms before continuing to approach businesses within Tennessee who desire to put environmental CSR spending budgets towards local economies. Cities will also play a role in the execution of getting businesses involved as a secondary market since companies with large CSR budgets will be established in areas with high volumes of people. Knoxville, Chattanooga, and their surrounding counties will be the first target locations before expanding toward Nashville and counties in the middle of the state as well as expanding towards Johnson City and its surrounding areas.

4.0 External Drivers of the Market

Environmental Consulting

- **Corporate profit**
  - "Corporate profit measures profit earned across all industries in the United States. An increase in corporate profit drives business spending on discretionary environmental reforms and enables businesses to invest in consulting services. Therefore, an increase in corporate profit precipitates rising industry revenue."
- **Industrial production index- Expanding to industrial agribusinesses**
  - "The industrial production index measures output from mining, manufacturing, electric and gas industries. Rising industrial production leads to increases in hazardous environmental emissions, such as air pollution from manufacturing plants, resulting in a need for the industry's services."
- **Value of construction- Building/incorporating the net-zero systems**
  - "The value of construction measures the total dollar value of both private and public construction work done in the United States. The construction sector is a major market for environmental consultants; therefore, an increase in construction activity will boost the need for environmental consulting services and raise revenue for the industry."
- **Tax credits for energy efficiency**
  - "Increases in tax credits for energy efficiency from government organizations translates into higher demand for industry services. Higher tax credits give companies more incentive to implement energy-efficient practices, generating greater demand for consultants to evaluate and implement possible solutions."

Dairy Farming

- **Price of milk**
  - "Downstream dairy processors and the government generally set milk prices, largely dictating revenue for dairy farms. An increase in milk prices encourages farmers to devote more resources to milk production, while falling prices causes declines in revenue."
- **Demand from dairy product production**
  - "Raw milk is a key ingredient in producing cheese, yogurt and ice cream; this means that downstream manufacturers of dairy products demand milk from industry players. A rise in demand for dairy products will increase the amount of milk used as an input in dairy processing."
- **Price of feed**
  - "On average, feed purchases account for slightly more than half of the cost of milk production. Over the past five years, rising feed costs have reduced income for many dairy farms. However, feed prices are often passed on to downstream markets, increasing milk prices and revenue."
- **Per capita dairy consumption**
  - "Since milk and many dairy products are considered dietary staples in the United States, per capita consumption fluctuates only marginally and generally hinges on population growth."

4.1 Primary Competitors

There are no direct competitors found for environmental consulting focused on farming in Tennessee, but there are multiple indirect competitors providing environmental consulting services in similar initiatives such as sustainability and energy. Below are the main ones in the Knoxville and Chattanooga areas with lists highlighting their similar services:

- *Strata G- Knoxville*
  - Environment
    - "Ensure environmental compliance and reduce costs
    - Organize and execute environmental audits
    - Integrate operational activities with environmental requirements
    - Negotiate and implement air, water, and waste permits (CAA, NPDES, RCRA, TSCA, CERCLA)
    - Develop and support P2 programs (Executive Order 13423) compliant with Iso 14001
    - Environmental Management Systems (EMS)"

- Sustainability

    - “Provide LEED pre-audit analysis with preliminary scoring to envision the desired LEED ratings and help customers achieve LEED goals
    - Develop cost estimates for implementing green measures
    - Document carbon footprint reduction achieved through sustainable activities
    - Provide Certified Energy Managers, LEED AP staff, and award winning P2 professionals to help you achieve your sustainability goals”

- *Streamline Environmental- Knoxville*

    - Waste Management

        - “Obtaining EPA ID numbers, if applicable
        - Inventory wastes
        - Waste determination
        - Packaging and consolidation
        - Labeling and transportation
        - Records management
        - Internal auditing
        - Preparation of Waste Management Plans”

    - Surface Water, Groundwater, and Sediment Studies

        - “Risk Analysis
        - Stormwater Permitting
        - Reservoir Design
        - Groundwater Resources
        - Dredging Operations
        - Large Scale Catchment Studies
        - Landfills
        - Wetland Treatment Systems
        - Ambient Water Quality Monitoring
        - Ecological Restoration”

    - Environmental Program Management

        - “Permit Acquisition and Compliance
        - Stormwater Management

- Chemical Inventory Maintenance
- Waste Minimization Programs
- Storage Tank Management
- Hazardous Material Transportation
- Emergency Response
- NEPA Assessments
- SWPPP & SPCC Plans”

❖ *PM Environmental- Chattanooga*

➢ Energy and Sustainability Consulting

- “Building Energy Auditing, Modeling & Simulation and Benchmarking
- USGBC LEED Consulting
- Code Compliance Assessments
- Utility Consumption Baseline
- Building Commissioning
- Thermal Imaging
- Building Shell Air Infiltration Testing (Blower Door Testing)
- Federal, State, Local, & Utility Energy Incentive Identification
- HUD Green Physical Needs Assessments (GPNAs) & Energy audits”

➢ EPA Grant Procurement and Management

- Grant Application Preparation and Reviews
- Community Outreach Assistance
- Site Inventory Development (including GIS databases)
- QAPP Preparation
- Grant Management and Programmatic Assistance
- ACRES Database Management
- Quarterly Reporting

❖ *Energy Efficiency and Sustainability Consulting- Chattanooga*

➢ Energy Efficiency

- Alternative Energy Solutions
- Building Envelope Solutions
- Control Solutions
- HVAC Solutions
- Lighting Solutions

- Power Saving Solutions
- Refrigeration Solutions

➢ Sustainability

- Water Conservation Services

5.0A Business Strategy and Implementation

The LDEC, LLC business strategy is to introduce a new industry model that capitalizes on the following:

Key Competitive Capabilities

- Integration of cost cutting and environmentally friendly practices (see *Appendix B* for examples).
- Link to a direct community partner and/or grant writing to assist with funding costs (overcomes biggest barrier of funding).
- Ability to take advantage of government incentives (e.g. tax credits)
- Position industry to become more small scale, thus supporting small farmers. See *Appendix A*, pages 46-49, for more background information.
- Reclaim food dollars to stay in cities and communities across the state of Tennessee as well as the Southeast region.
- Implementation of sustainable development initiatives (builds local communities).

5.0B Strategy Implementation

Implementation of net-zero initiatives by LDEC, LLC will be considered in five phases: securing funding, incorporating renewable energy, installing renewable water, planning for “renewable” waste, and scheduling follow up appointments. These phases will be discussed and recommended in the sequential order on a one phase per year plan to

spread cost amounts over an annual duration; however, farms are allowed to proceed with implementations at their own pace, if desired.

Phase I: (Secure funding)

The first step in making LDEC, LLC a successful consulting firm relies on finding funding for the small farms and/or ensuring that farms are aware of all possible incentives. Some farms may not need or want outside funding, but considering the fact that new technologies have the potential to be costly, a funding option is desired. Grant and loan writing services will be provided as the first funding option, and the second option of funding will come from sponsorships. The USDA Rural Energy for America Program (REAP) grant is the main target grant for solar energy installation. This grant covers up to $20,000 of a renewable energy project's cost. The USDA REAP Guaranteed Loan Program also provides a maximum of 25 million dollars for renewable energy projects. LDEC, LLC is prepared to approach businesses with an environmental CSR sponsorship opportunity to help educate on how farming affects the local economy and impacts individuals. Businesses are beginning to increase CSR spending efforts to build a better company brand image, and this farm sponsorship will be a unique approach to keeping money local. Incentives for companies to sponsor include tax write-offs, advertising by LDEC, LLC and the farm, discounted consulting services from LDEC, LLC, and assistance in achieving green certification statuses (see *Appendix C* for examples).

The grant approach typically includes a one-time grant amount per grant received, but the sponsorship option will be an annual amount for the duration of phase implementation. This allows businesses to spread out their cash flows over time while continually being involved in the process and claiming the credit for assisting a local farm.

This defining period of the project will not only include the funding portion of the project but also the goals, specifications, tasks, and responsibilities of all parties involved. Scheduling monthly meetings with the farms, and businesses or sponsors if involved, determining the phase by phase budget, collecting and allocating resources, discussing risks and risk limiting approaches, and researching suppliers, contractors, and other necessary parties will occur during this phase.

Phase II: (Energy)

The second phase consists of alternative energy implementation. Farms will start by increasing energy efficiency by switching to LED lightbulbs, censored light systems, double glazed windows, proper insulation, installed energy meters, milk cooling plates, heat exchangers, and variable frequency drives, among other options. Upon completion of the energy efficiency techniques, the farms will be prepped to move into the on-site renewables portion of the phase. Photovoltaic (PV) panels are a primary source of renewable energy and will be the first suggestion by LDEC, LLC; however, wind, water, and other solar options are also available, if farms so choose. Once there has been an 80 percent reduction in energy via efficiency methods and on-site renewables, the farm can choose to utilize off-site renewables or offsetting efforts to achieve complete net-zero energy.

The Design, Construction, and Operation Objectives for energy are as followed:

- Design the renovation to be a high performance, energy efficient building
- Use metered data to calibrate the renovated building's energy model
- Design renewable energy systems to generate the source energy of greater of the modeled annual energy use
- Minimize the impact of design reviews or value engineering on the net zero target
- Commission the building energy systems
- Develop a building operation plan to address operations and management of energy efficiency design features and renewable energy technology
    - Description of measures
    - Action items that need to be performed
    - Schedule
    - Personnel responsible
- Meter energy use and production and benchmark performance
- Measure and verify building is operating at net zero over a one-year timeframe

Status reports will be assessed at the end of every implemented initiative. Any changes to the project as a whole will be addressed at the end of the phase, and the scope of the project will be updated. At the end of the phase, forecasts for returns on investments and payback periods will be created and shared with farms and business sponsors, if applicable.

See *Appendix B* for example pricing information.

Phase III: (Water)

Phase III begins with water efficiency techniques. Initiatives such as tap fittings for flow control, drip irrigation, water meters, and options of the like, are all examples of starter implementations. After water efficiency methods are in place, on-site solutions can now be started. Capturing and reusing rainwater, stormwater, wastewater, and greywater are recommended on-site options. Investing in a dual plumbing system or an on-site water treatment system are both pathways to achieving a complete net-zero water system.

The Design, Construction, and Operation Objectives for water are as followed:

- Design the renovation to be a high performance, water efficient building
- Meter water use and develop water balance by end-use
- Maximize alternative water sources
- Treat wastewater on-site and return the original water to source as much as possible
- Design green infrastructure features to return water to its original water source
- Minimize the impact of design reviews or value engineering on the net zero target
- Commission the building’s water and wastewater systems
- Develop a building operation plan to address operation and management of water efficient design features, alternative water systems, and wastewater treatment systems, and perform leak detection and water quality assessments
- Measure and verify the building is operating at net zero over a one-year timeframe

Just like Phase II, status reports will also be assessed at the end of every implemented initiative. Any desired changes to the project as a whole will be reviewed at the end of the phase, and the scope of the project will be corrected as needed. At the end of the phase, forecasts for returns on investments and payback periods will be created and shared with farms and business sponsors, if applicable.

See *Appendix B* for example pricing information.

Phase IV: (Waste)

To start Phase IV, waste reduction is the beginning step. Waste generation, materials used, and building function are the three highest waste generating portions of design operations. Switching to recyclable material, composting food and landscaping wastes, and repurposing cow waste will cut back on total waste generated. Utilizing environmentally friendly materials and locally or regionally sourcing necessary materials will reduce material use while upgrading building design, or barn design in farm instances, will address building function waste performance. Once an 80 percent waste reduction mark is met, the next step of net-zero waste can be approached. Writing a site waste management plan detailing waste reduction and how recyclables will be handled, waste stream audits, operation and management plan for wastes, and educating staff, contractors, suppliers, and other parties are all examples of ensuring net-zero waste efforts are achieved.

The Design, Construction, and Operation Objectives for waste are as followed:

- Assess waste stream composition of existing building and the impact on waste for the renovated building
- Develop green procurement program that minimizes waste generation
- Design, reuse, recycle, and compost programs to minimize waste generation
- Establish contracts with local entities to support purchasing, reuse, recycling, compost, or other waste management efforts for milk and/or milk container recycling as well as local purchasing

- Establish closed-loop system to repurpose manure wastes in a functional manner of the farm, such as in a biodigester
- Building operation plan addresses operation and management of waste conversion programs
- Measure and verify building is operating at net zero over a one-year timeframe

Similar to Phases II and III, status reports will also be assessed at the end of every plan, effort, and change made. Any last alterations to the project overview will be discussed at the end of the phase, and the scope of the project will be adjusted. At the end of the phase, forecasts for returns on investments and payback periods will be created and shared with farms and business sponsors, if applicable.

See *Appendix B* for example pricing information.

Phase V: (Follow ups)

Phase V of the transition to net-zero operations consists of follow up visits. For the final portion of the implementation, LDEC, LLC will schedule monthly follow ups with the farms and businesses to ensure the net-zero initiatives are running smoothly, training on equipment use is up to date, and close out the project. Transferring necessary documents, providing training, discussing evaluations and lessons, and releasing any other resources are all apart of this phase. In addition to monthly follow ups, the last phase is used to monitor net-zero goals and systems. After Phase V ends, LDEC, LLC will follow up bi-annually, or as often as a farm requests, with the farms to keep contact and check in on system operations.

5.1 Marketing Strategy

LDEC, LLC realizes that the established agriculture industry makes it harder for smaller farms to have enough disposable income to cover costs; however, with other small farms with net-zero efforts already in existence, it is doable.

The LDEC, LLC marketing strategy entails the intermediation of a financial supporter in the form of either a grant or a local business sponsorship to ensure a minimal financial burden on farms moving forward in this process. By including other people in this process beyond farmers, the surrounding community can be involved in the transformation and increase their education around agriculture, like buying local.

The payment cycles will be paid on a per-project basis either all up front (if a sponsorship is confirmed) or on a monthly-basis (if the farmer prefers to pay out of pocket or any grant contingencies request). It will be a 12 percent (of the total project cost) consulting fee for phases I, II, and III, while phases IV and V are both 8 percent fees.

The goal of the LDEC, LLC marketing strategy is to not only gain clientele for the company but also gain sponsors for the client. LDEC, LLC will meet with companies to plan and propose an “Environmental CSR” plan that will detail the need for sponsorship funds, the benefits of sponsorship (e.g. tax advantages, company morale, community support, discounted LDEC, LLC services) and detail of how funds will be used.

Once a sponsorship is secured, LDEC, LLC will mediate funds for the net-zero process and assist farms in executing the projects while keeping sponsors in the loop on progress.

The following chart demonstrates an overview of the LDEC, LLC marketing strategy.

6.0 Management Summary

Lauren Dunn as the sole owner will understand the workings of the Director of Design and the Director of Marketing but will focus on overseeing day-to-day activities as well

as business operations as a whole. The intent is to be able to execute daily operations between the three managing members and gain the experience and skill necessary for success and expansion. The three main employees will run the office until further employees are deemed necessary.

6.1 Personnel Plan

The management summary overviews the direct and active involvement of the company owner in all stages of the start-up, purchasing, and running of the service.

There will be two other managing members—Director of Design and Director of Marketing—added to the team, one during the first year (Director of Design) and one during the second year (Director of Marketing). The Director of Design will be required to have engineering expertise or architectural expertise by the interview period in May 2019 and will work 8 hours daily, five days a week, to reach full-time status. There will be a one hour daily break along with two days off per week. The Director of Marketing will be added to the team in May 2019 as well and will require some public relations or marketing expertise. This decision is based on start-up costs and funding needed for salaries. Both positions will require a formal training period lasting at least two weeks, so the team members understand the vision, goals, and mission of the company as well as each member's individual roles and expectations. From there, it will be a collaborative effort to startup the company and get clients in order to operate at full-time.

Director of Marketing KSAs:

Knowledge	Skills	Abilities	Work Activities
Sales and Marketing	Active Listening	Information Ordering	Direct Financial Operations for Clients
Customer and Personal Service	Critical Thinking	Visualization	Present Information to Clients and Sponsors
English Language	Judgement and Decision Making	Problem Sensitivity	Manage Budgets
Communication and Media	Reading Comprehension	Written Comprehension	Maintain Operational Records
Administration and Management	Communication	Presentation	Assist in Grant or Loan Writing
Clerical	Proofreading	Speech Clarity	Monitor External Affairs Affecting Business
Psychology	Active Learning	Fluency of Ideas	Coordinate with External Parties to Exchange Information
Laws and Government Policies	Persuasion	Originality	Edit Documents
	Time Management	Oral Comprehension	Market Sponsorship Opportunities
	Complex Problem Solving	Written Expression	Develop Promotional Plans
	Systems Analysis	Oral Expression	
	Writing	Inductive Reasoning	
	Management of Financial Resources	Deductive Reasoning	
	Public Speaking		

Director of Design (Architect Background) KSAs:

Knowledge	Skills	Abilities	Work Activities
Design	Active Listening	Near Vision	Create Graphical Representations of Projects or Structures
Building and Construction	Critical Thinking	Visualization	Operate Computer Systems (i.e. CAD)
English Language	Judgement and Decision Making	Problem Sensitivity	Evaluate Technical Data to Determine Effects on Plans
Engineering and Technology	Reading Comprehension	Written Comprehension	Collect Data on Project Sites
Mathematics	Communication	Finger Dexterity	Supervise Engineering or Other Personnel
Law and Government Policies	Coordination	Arm-Hand Steadiness	Determine Operational Methods
Computers and Electronics	Active Learning	Fluency of Ideas	Estimate Technical or Resource Requirements for Plans
Customers and Personal Service	Monitoring	Originality	Monitor Process with Standard Compliance
	Time Management	Mathematical Reasoning	Provide Technical Guidance
	Complex Problem Solving	Written Expression	Recommend Technical Design or Process Changes
	Systems Analysis	Oral Expression	Estimate Operational Costs
		Inductive Reasoning	Create Physical Models or Prototypes
		Deductive Reasoning	

Director of Design (Engineering Background) KSAs:

Knowledge	Skills	Abilities	Work Activities
Engineering and Technology	Critical Thinking	Communication Comprehension	Design Environmental Control Systems
Chemistry	Reading Comprehension	Problem Sensitivity	Determine Compliance with Standards
Mathematics	Systems Evaluations	Deductive Reasoning	Communicate with Persons Outside of Organization
English Language	Complex Problem Solving	Communication Expression	Direct Environmental Development Activities
Law and Government Policies	Judgement and Decision Making	Inductive Reasoning	Process Information
Design	Systems Analysis	Fluency of Ideas	Interpret the Meaning of Information to Others
Physics	Effective Communication	Mathmatical Reasoning	Establish and Maintain Relationships
Public Safety and Security	Time Management	Originality	Estimate Quantifiable Characteristics of Net-Zero Systems
Biology	Coordination	Visualization	Coordinate the Work and Activities to Others
Customer and Personnel Service	Instructing	Selective Attention	Monitor Processes and Intiatives Implementation
Building and Construction	Science	Speed of Closure	Provide Consultation and Advice to Others
Administration and Management	Negotiation		Schedule Work and Activities
Mechanical	Active Learning		Inspect Equipment, Structures, or Material
Geography	Service Orientation		Investigate Environmental Impact of Projects
Education and Teaching	Monitoring		Draft and Specify Technical Systems
Computers and Electronics			Prepare Detailed Work Plans
General Agriculture			Explain Job Details to General Public

Monetary compensation of the Director of Design will start around $54,870, depending on if this applicant has more architectural background or engineering background. The compensation for the Director of Marketing will start around $50,390, depending on if he/she have experience in marketing, public relations, or fundraising management. The

Environmental Manager will start around $55,000, but she will be the last to be paid salary since she is the owner and will reinvest profit back into the start-up.

LDEC, LLC expects to have a strong benefits policy in hopes of lowering the turnover rate. There will be a payroll burden around 15 percent of the salary to cover SUTA, FUTA, FICA, and all other applicable taxes. Benefits include, but are not limited to

- ❖ Deferred compensation to contributory 401k and 457 plans
- ❖ Health and dental insurance
- ❖ Low cost life insurance
- ❖ 11 paid holidays
- ❖ Sick day leave accumulates
- ❖ One paid college course per semester (when applicable)

The total compensation and benefits cost per person are as followed

Position	Compensation Total	Benefits Total	Total Amount
Environmental Manager	$55,000	$16,500	$71,500
Director of Design	$54,870	$16,461	$71,331
Director of Marketing	$50,390	$15,117	$65,507

7.0 Financial Plan

LDEC, LLC will apply for multiple small business grants in hopes being awarded one (or multiple) and avoiding a loan. Examples of potential grants are

1. Small Business Innovation Research Program
The U.S. Department of Agriculture is a participating federal agency with there being three phases to this funding displayed as follows:

> ***Phase I.*** *The objective of Phase I is to establish the technical merit, feasibility, and commercial potential of the proposed R/R&D efforts and to determine the*

quality of performance of the small business awardee organization prior to providing further Federal support in Phase II. SBIR Phase I awards normally do not exceed $150,000 total costs for 6 months.
Phase II. *The objective of Phase II is to continue the R/R&D efforts initiated in Phase I. Funding is based on the results achieved in Phase I and the scientific and technical merit and commercial potential of the project proposed in Phase II. Only Phase I awardees are eligible for a Phase II award. SBIR Phase II awards normally do not exceed $1,000,000 total costs for 2 years.*
Phase III*. The objective of Phase III, where appropriate, is for the small business to pursue commercialization objectives resulting from the Phase I/II R/R&D activities. The SBIR program does not fund Phase III. Some Federal agencies, Phase III may involve follow-on non-SBIR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government.*

One of the 2019 topics of interest is rural solar, making this a prime opportunity for funding.

2. Small Business Technology Transfer Program
Another grant program offered by the U.S. Small Business Association is the Small Business Technology Transfer Program. This program offers funding to help "foster the innovation necessary to meet the nation's scientific and technological challenges in the 21st century." Despite the fact that the USDA is not one of five U.S. departments required to reserve a portion of research and development dollars for this program, the Department of Energy is an included program. The three phases of funding comprise of:

Phase I *is the startup phase. Awards of up to $100,000 for approximately one year fund the exploration of the scientific, technical, and commercial feasibility of an idea or technology.*
Phase II *awards of up to $750,000, for as long as two years, expand Phase I results. During this period, the R&D work is performed and the developer begins to consider commercial potential. Only Phase I award winners are considered for Phase II.*
Phase III *is the period during which Phase II innovation moves from the laboratory into the marketplace. No STTR funds support this phase. The small business must find funding in the private sector or other non-STTR federal agency funding.*

If LDEC, LLC fails to receive any start-up funding, LDEC, LLC will be looking for a short-term loan to give the company the ability to pay salary to employees and pay startup costs. Because we are a service organization, there is little need to purchase equipment or other costly capital purchases; however, there potentially could be costs for research and development.

7.1 Important Assumptions

The financial plan is based on important assumptions, detailed in the following statements:

- Grants or sponsorships can be obtained for the farms to initially fund the processes (funding is available).
- Farmers are willing to invest in systems that will cut costs in the long-term.
- The “long-term” payback period is around eight to ten years on average for projects.
- Costs for implementing sustainability and net-zero systems remain constant or decrease.
- LDEC, LLC can remain competitive in service pricing with established competitors as a startup business.
- Solar energy/green energy pushes in the U.S. continue growing through research and development as well as funding opportunities.
- Adequate capital and financing is available for net-zero project plan elements.
- The consumer/societal “green trend” continues.

7.2 Revenues and Expenses

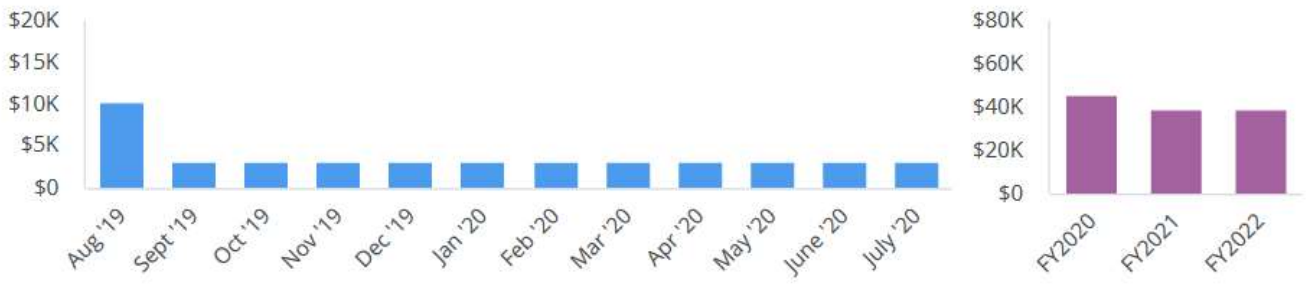
The revenues for LDEC, LLC are set by the phases of implementation, with one phase representing one year.

Revenue

Revenue	FY2020	FY2021	FY2022
Net Zero Group One	$188,100	$120,000	$80,004
Net Zero Group Two		$188,100	$120,000
Net Zero Group Three			$188,100
Totals	**$188,100**	**$308,100**	**$388,104**

The revenues for the first three years are based off of the three sets of clients (10 additional clients a year).Phases I (funding) and II (energy) both cost the client 12 percent of the total project cost, where the project cost for energy is estimated at $138,000. In addition, there is a one-time fee of $2,250 per client for the finding funding portion. In total, phases I and II cost $188,100 for the first 10 farms. Phase III (water) is also based on a 12 percent total project cost. LDEC, LLC based the water systems at about $100,000, bringing in $10,000 for LDEC, LLC per month in year two. Phase IV (waste) is estimated at about $80,000, and LDEC, LLC is only charging an 8 percent of the total project cost for consulting fees as an incentive to retain clients throughout the whole program. The total cost for each farm was determined and divided by 12 to spread the revenues out on a monthly basis during the course of the year.

Expenses



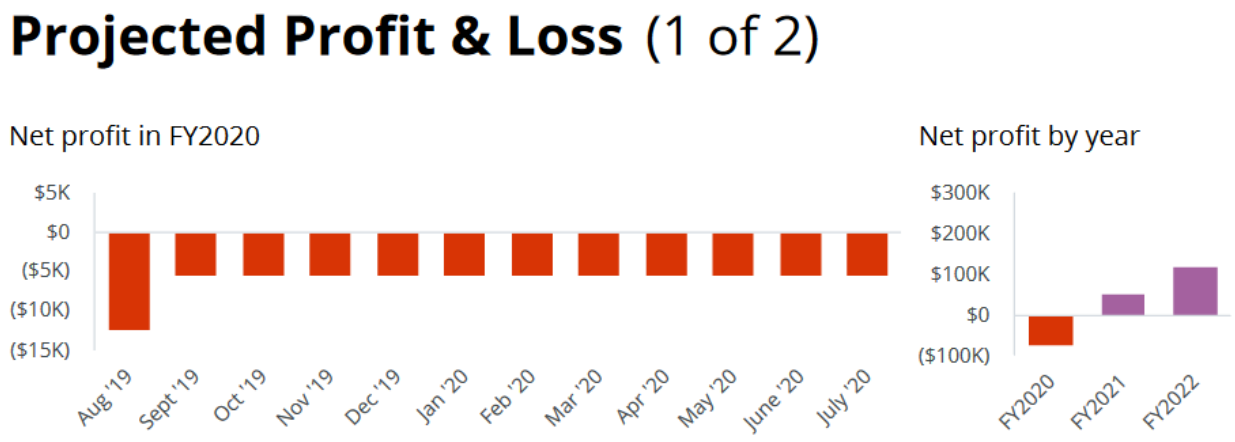
The expenses for the first three years are based on the following breakdown.

Expenses	FY2020	FY2021	FY2022
Marketing Costs	$6,800	$6,800	$6,800
Utilities	$1,380	$1,380	$1,380
Rent	$13,800	$13,800	$13,800
Insurance	$3,000	$3,000	$3,000
Website	$600	$600	$600
Office Furniture	$6,000		
LLC Fees	$1,000		
Office Supplies	$1,500	$1,500	$1,500
Gas Reimbursment	$12,000	$12,000	$12,000
Totals	**$46,080**	**$39,080**	**$39,080**

Since word of mouth and active outreach are the two main sources of advertising for the startup, LDEC, LLC is spending about 3.5 percent of Year One's revenue for marketing expenses. LDEC, LLC decided to keep that number to use for the first three years for simplicity's sake but will make adjustments, if needed. Utilities and insurance costs are just average estimates in the state of Tennessee, while the annual rent cost is based upon an office location in Lenoir City, Tennessee (103 W Broadway St.). Office supplies is based on spending $125 a month on necessary items such as paper, paperclips, pens, sticky notes, highlighters, stapler, hole punch, and other general supplies. The gas reimbursement was calculated based on 50 cents per mile reimbursement, up to 150 miles a trip, making it no more than $150 in reimbursement per farm visit. That makes it $1,500 to visit each farm once and allows LDEC, LLC to make farm visits at least 8 times each based on the maximum miles for reimbursement. **Without renting**

an office space and working from home, the total startup expenses become $32,280 in year 1 and $25,280 in years 2 and 3. Cost estimates that include salary expenses will be noted in the next sections.

7.3 Projected Profit and Loss



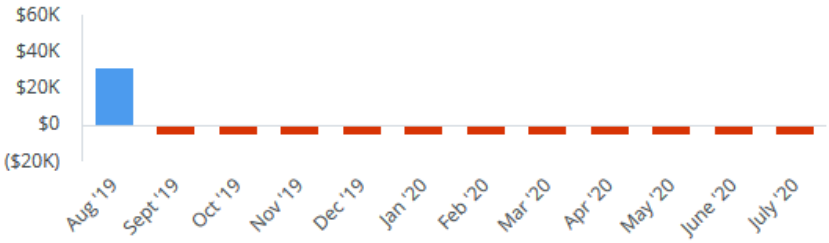
Projected Profit & Loss	FY2020	FY2021	FY2022
Revenue	**$188,100**	**$308,100**	**$388,104**
Net Zero Group One	$188,100	$120,000	$80,004
Net Zero Group Two		$188,100	$120,000
Net Zero Group Three			$188,100
Gross Margin	$188,100	$308,100	$388,104
Gross Margin %	100%	100%	100%
Operating Expenses	**$255,918**	**$251,585**	**$255,835**
Salaries & Wages	$160,260	$163,465	$166,735
Director of Marketing	$50,390	$51,398	$52,426
Environmental Manager	$55,000	$56,100	$57,222
Director of Design	$54,870	$55,967	$57,087
Employee Related Expenses	$48,078	$49,040	$50,020
Marketing Costs	$6,800	$6,800	$6,800
Utilities	$1,380	$1,380	$1,380
Rent	$13,800	$13,800	$13,800
Insurance	$3,000	$3,000	$3,000
Website	$600	$600	$600
Office Furniture	$6,000		
LLC Fees	$1,000		
Office Supplies	$1,500	$1,500	$1,500
Gas Reimbursment	$12,000	$12,000	$12,000
Amortization of Other Current Assets	$1,500		
Operating Income	**($67,818)**	**$56,515**	**$132,269**
Interest Expense	$2,121	$1,872	$1,388

Projected Profit & Loss	FY2020	FY2021	FY2022
Income Taxes	$0	$0	$7,346
Depreciation and Amortization	$857	$857	$857
Total Expenses	$258,896	$254,314	$265,427
Net Profit	($70,796)	$53,786	$122,677
Net Profit %	**(38%)**	**17%**	**32%**

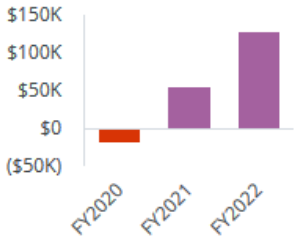
7.4 Projected Cash Flow

Projected Cash Flow

Cash flow in FY2020



Cash flow by year



Projected Cash Flow	FY2020	FY2021	FY2022
Net Cash from Operations	**($51,040)**	**$65,744**	**$138,279**
Net Profit	($70,796)	$53,786	$122,677
Depreciation and Amortization	$2,357	$857	$857
Change in Accounts Receivable	$0	$0	$0
Change in Accounts Payable	$0	$0	$0
Change in Income Tax Payable	$0	$0	$7,346
Change in Sales Tax Payable	$17,399	$11,101	$7,399
Net Cash from Investing	**($7,500)**		
Assets Purchased or Sold	($7,500)		
Net Cash from Financing	**$41,737**	**($9,456)**	**($9,940)**
Change in Short-Term Debt	$9,456	$484	$509
Change in Long-Term Debt	$32,281	($9,940)	($10,448)
Cash at Beginning of Period	$0	($16,803)	$39,486
Net Change in Cash	($16,803)	$56,288	$128,340
Cash at End of Period	**($16,803)**	**$39,486**	**$167,825**

The negative cash flow in the first year will be covered by taking from the Environmental Manager's salary. If the cash at the end of the period greatly exceeds the projected amount, another small loan will be taken out to cover the difference.

7.5 Projected Balance Sheet

Projected Balance Sheet

Projected Balance Sheet	FY2020	FY2021	FY2022
Assets	**($11,660)**	**$43,771**	**$171,254**
Current Assets	**($16,803)**	**$39,486**	**$167,825**
Cash	($16,803)	$39,486	$167,825
Accounts Receivable	$0	$0	$0
Other Current Assets	$0	$0	$0
Long-Term Assets	**$5,143**	**$4,286**	**$3,429**
Long-Term Assets	$6,000	$6,000	$6,000
Accumulated Depreciation	($857)	($1,714)	($2,571)
Liabilities & Equity	**($11,660)**	**$43,771**	**$171,254**
Liabilities	**$59,136**	**$60,781**	**$65,586**
Current Liabilities	**$26,855**	**$38,440**	**$53,693**
Accounts Payable	$0	$0	$0
Income Taxes Payable	$0	$0	$7,346
Sales Taxes Payable	$17,399	$28,500	$35,899
Short-Term Debt	$9,456	$9,940	$10,448
Long-Term Liabilities	**$32,281**	**$22,341**	**$11,893**
Long-Term Debt	$32,281	$22,341	$11,893
Equity	**($70,796)**	**($17,010)**	**$105,667**
Retained Earnings		($70,796)	($17,010)
Earnings	($70,796)	$53,786	$122,677

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Appendix A

Introduction:

The beauty of agriculture is that it provides the basis for life on earth. Food is a necessity for all living things, and without it, life would cease to exist. From a business standpoint, this set-up is ideal because the demand and the need for food will never go away, so agriculture should, hypothetically, always thrive. In addition, the continuous shift to more industrialized methods of farming showcases one of businesses' favorite practices: efficiency. The combination of operation costs mixed with the number of animals and crops as outputs result in revenues, profits, and numbers, so tapping into this industry seems promising.

This business plan highlights a potential solution framed around the livelihood of small dairy farmers (fewer than 500 cows) in the state of Tennessee and the environmental concerns associated with large scale agriculture. The plan walks you through an approach to confront the dying operation of small farming and the negative environmental effects of farming as a whole through the lens of an environmental consulting business offering net zero initiatives--initiatives creating a closed-loop systems for energy/carbon, water, and waste processes by equaling out the consumption of energy/carbon, water, or waste with amounts produced by renewable sources. The goal of this business plan is to to ultimately answer the questions would net-zero initiatives be a feasible option for small to medium size farms to implement, and by default, would these initiatives be costly or cost-cutting?

The need for such initiatives on farms derives from the never-ending innate demand for food that will only continue to grow as the global population increases. George Pyle (2005) states it well when he writes,

> "No matter how demanding people get, the human need for food does not automatically translate to the kind of demand economists mean when they talk, as they always do, about the Law of Supply and Demand. The desire for food, moderate or severe, normal or desperate, becomes economic 'demand' only when it is accompanied by money. Without money, there is hunger, but it is not the kind of demand that will get anybody fed. Or make a profit for any farmer," (60).

Pyle paints this picture implying a transition of farming goals from life necessity to corporate profit. Farming is no longer an art or a skill, but rather, it is now an assembly line where a handful of companies control the game, set the standards, and reap the majority of benefits at the expense of the environment and small, independent farmers (Pyle, 2005, p. xvii; Stoll, 2006, p. 809; Woodhouse, 2010, p. 438). The argument is frequently made that industrial agriculture is how the increasing world population will be fed, and it is the only way to feed the growing world. This notion is actually false. Underproduction in the United States is not the problem; overproduction of staple crops (corn, wheat, and rice) is the problem, driving the supply up to an excess amount and driving the profit to farmers down (Pyle, 2005, p. xiii; Woodhouse, 2010, p. 438). It is also contended that industrialization of the agriculture industry keeps food prices down (or it at least appears to the consumer that way), but at what long-term cost (Ikerd, 1993, p. 151)? The problem with current agriculture methods lies within two realizations:

1) if current farming methods continue, farming as a profession will die out, causing large agribusinesses alone the inability to meet the demands of consumers (due to the fact that they are only meeting the demand now since the government subsidizes farmers to produce what agribusinesses want, thus without small farms, large farms cannot meet the demands on their own account), and 2) if society depletes the resources on which food production relies on (i.e. water, soil, plants, and animals), food will run out. The transition from farm focus to factory focus to produce the necessary outputs is now a transition raising questions and increasing concerns about the long-term consequences of such production methods. Finding a balance between economic benefits and environmental health, while taking independent farmers into the equation is a critical goal moving forward for this industry.

The Importance of Agriculture: An Overview of the Economy

Despite the daily intake of food, it seems that the relationship humans have with food stops when food leaves the grocery store because the thought behind where food comes from, how it is grown, and who grows it appears to be neglected due to the factor of convenience. Whether it is because of a lack of education on the food industry or the lack of interest, the significance of food is critical to individuals and the nation.

In the United States alone, 992 billion dollars of the United State's gross domestic product comes from agriculture, food, and food related industries creating 11 percent of total employment, which is about 21.6 million full and part-time jobs (Morrison, Melton, and Kassel, 2018). 12.9 percent of Americans' household expenditures comes from food purchases, and the largest share of the United States

Department of Agriculture (USDA) outlays comes from food and nutrition assistance programs (Morrison, Melton, and Kassel, 2018). The agriculture and food system is a key economic driver in the U.S. generating 2 trillion dollars of revenue and about 130 billion dollars of profit for almost 3 million businesses in the industry. It also accounts for 9 percent of U.S. exports ("American agriculture drives economic growth", 2018). Agriculture and its related industries have a multitude of influences on the U.S. economy. Agriculture contributes to national income, infrastructure, and capital formation. Agriculture provides employment, a food supply and improves rural welfare.

However, despite the multitude of economic benefits, the reality of agriculture is its influence is in the hands of a few in essentially all agriculture sectors, which causes a desperate situation for small, independent farmers. For example, there is a four-firm concentration in the chicken industry with Tyson, Gold Kist, Perdue Farms, and Pilgrim's Pride controlling about 40 percent of the market share (Pyle, 2005, p.12). This gives them the power to control the price of a given commodity without any explicit complicity (Pyle, 2005, p.13; Stoll, 2006, p.810; "Contract farming resource center", 2019). The power extends beyond the price. Processors often own the birds that small farmers raise, so the processing firms are the ones to set rules for proper growing, feeding, and medical care for the birds as well as any rules for handling complaints from neighbors about odors, pollution, or any other issues. However, it is the grower that is responsible for any crises and all monetary responsibility to ensure these rules are met. Growers are often required to sign secrecy clauses in relation to rate of pay and working conditions, so they are left in the dark about if they are being treated fairly. Growers do not even know the market rate for comparison. The grower is at the mercy of the

processor, and if something goes wrong, the processor can always find another grower, but it is almost impossible for a grower to switch to another processor (Pyle, 2005, pp.14-15; Stoll, 2006, p.810). This example in the chicken industry is applicable to dairy because the concentration of power in all agriculture sectors goes back to the bargaining power of the agribusinesses and their influences on small farm operations.

The industrialization of farms is the underlying cause for corporate power in this industry and became a rising issue in the 1990s (Pyle, 2005, xxi). The idea of cheap food encourages policies and actions to bring efficiency to the food production sector. The Environmental Protection Agency explains,

> "Technological developments in agriculture have been influential in driving changes in the farm sector. Innovations in animal and crop genetics, chemicals, equipment, and farm organization have enabled continuing output growth without adding much to inputs. As a result, even as the amount of land and labor used in farming declined, total farm output more than doubled between 1948 and 2015," (Kassel, 2018)

These innovations resulted in small farmers investing what little cash flow they had and/or receiving a bank loan to buy more equipment or more land in attempts to keep up with the growing demands and cost cutting tactics (Pyle, 2005, p.8). As a result, money is not saved for a "rainy day", and many farmers depreciate equipment and mortgage land, both holding little monetary value, and ultimately, the number of farmers has been decreasing ever since (Pyle, 2005, pp. 8-9; Kassel, K., 2018). The U.S. farm system is so ownership centralized that over 66 percent of the country's entire agriculture output is now coming from less than 33 percent of the nation's farms

(Roberts, 2006, p.26; Ikerd, 1993, p.150). Smaller farmers acknowledge that the subsidies the U.S. government provides for specific production methods are more for large agribusiness firms to ensure survival (Pyle, 2005, p.65). Despite the economic benefits and the low cost of food to consumers, current commodity operations are driving out farmers creating a concern for sustainable food production moving forward.

The Importance of Agriculture: An Overview of Environmental Health

The cheap food costs in the agriculture industry are only cheap to the consumers, and these costs are not as low cost as they seem when all factors are included in the equation, especially environmental concerns. Food production inputs are all threatened by the world's current methods of agriculture, and with no synthetic versions of food in existence, the human species is putting itself at risk (Roberts 2008, p.xxiii; Ikerd, 1993, p.150). By the 2050s, the human population is expected to reach almost 10 billion people, and not only will farmers be expected to feed larger populations, but they will also be doing so without the advantages of abundant water, cheap energy, and a stable climate (Sagasta, Zadeh, and Turral, 2017, p.5; Roberts 2008, p.xix; Woodhouse, 2010, p.439; "Contract Farming Resource Center.", 2019). Adjusting agriculture and food production practices to address the increasing world population and environmental concerns is a priority moving forward in this industry because of the impact this industry has on environmental health and, by default, human health. The environmental effects of farming are issues that consumers often overlook or do not understand. Trends in industrial agriculture spoil the land, poison the water, and threaten ecosystems as a whole. Water concerns, biodiversity loss, soil erosion,

carbon emissions, pesticide and fertilizer usage, antibiotic usage, crop vulnerability, land usage, and extreme energy consumption are all side effects to large scale farming outputs. Although there are multiple pressing needs within this industry, this paper highlights the concerns with water usage, land usage, soil alterations, climate change, and biodiversity loss.

Water

The relationship between water and farming is one that is critical to the production of crops and healthy livestock, yet there are concerns of over consumption and water pollution. For starters, the agriculture industry accounts for 70 percent of water withdrawal worldwide diverting water resources from other uses (Sagasta, Zadeh, and Turral, 2017, p.2; Woodhouse, 2010, p.439). The two main reasons for water withdrawal are irrigation for crops and for livestock (Sagasta, Zadeh, and Turral, 2017, p.5). Water consumption at unsustainable rates is not the only reason for depletion of usable water (Horrigan, Lawrence, and Walker, 2002, p.445; Ikerd, 1993, p.149), water pollution is also an issue limiting water long-term resources.

The three main sources of water pollution come from industry, agriculture, and human settlement, so the increase of human populations over time coupled with the increasing demand for food, is only going to enhance the problem if current production methods continue (Sagasta, Zadeh, and Turral, 2017, p.2). Agriculture in the U.S. is the main reason for pollution in streams and rivers, second for wetlands, and third for lakes (Horrigan, Lawrence, and Walker, 2002, p.447; Sagasta, Zadeh, and Turral, 2017, p.2). In a crop production setting, the problem arises when chemical pesticides and fertilizers,

such as nitrogen, phosphate, and ammonia, are used and contaminate groundwater or move into waterways through surface runoff (Horrigan, Lawrence, and Walker, 2002, p.445; Woodhouse, 2010,p. 438; Sagasta, Zadeh, and Turral, 2017, p.11; Pyle, 2005, p.xix). Irrigation also contributes to the salinization of soils, raising saline numbers in aquifers and groundwater (Sagasta, Zadeh, and Turral, 2017, p.14). In a livestock production setting, manure collected for fertilizer usage can be over applied and diffuse into nearby waterways, and the location of animal feedlots influences water contamination as well. Feedlots usually are placed on the banks of waterways where nutrient-rich animal waste ends up being released directly into waterways (Sagasta, Zadeh, and Turral, 2017, p.11). In many instances, food production causes farmers to pay for water purification and filtration systems that would not be needed if it were not for the nitrates used in fertilizer and animal wastes that find its way into water sources (Pyle, 2005, p.5).

Land and Soil

Monocropping, where farmers solely produce one type of crop instead of alternating crops throughout the year, has depleted soils and resulted in the loss of arable land. This practice also results in a loss of biodiversity along with soil nutrients, and in extreme cases, in desertification (Horrigan, Lawrence, and Walker, 2002, p.445; Woodhouse, 2010, p.438; Hamuda and Patko, 2010, p.90; Pyle, 2005,p. xix). Horrigan, Lawrence, and Walker (2002) reveal,

> "An extreme example of land degradation is the phenomenon known as desertification, which the United Nations has defined as "land degradation in arid,

> semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities"...Desertification reduces the amount of land available for agriculture. Agriculture can contribute directly to desertification through poor agricultural practices such as overcultivation, overgrazing, and overuse of water, and indirectly when land is deforested to create new cropland or new pastures for livestock," (447).

The intensive use of monocropping has led to a lower resilience within agriculture livelihoods and ecosystems and has left farmers with unusable land (FAO strategy on climate change., 2017, 29). About 15 percent of land is now deemed unusable, requiring more land to be dedicated to food production, where 30 percent of the planet's land surface is already devoted to food production alone (Horrigan, Lawrence, and Walker, 2002, p.447; Sagasta, Zadeh, and Turral, 2017, p.9). Soil erosion, nutrient loss, and soil compaction are all factors contributing to soil depletion and desertification.

Climate Change and the Loss of Biodiversity

The last major factor this overview will address is the effect of climate change on the relationship between the loss of biodiversity and agriculture ecosystems. The Food and Agriculture Organization of the United Nations (2017) asserts, "climate change poses large-scale threats to natural resources that are essential to agriculture production. Damage and depletion of natural resources undermines the natural ecological processes on which healthy, productive landscapes rely," (31). Nine point four percent of the U.S. greenhouse gas emissions comes from the agriculture and forestry industries, and on a worldwide scale, about a third of greenhouse gas

emissions comes from food production (Marshall, E., 2018; *Food and Agriculture Organization...*, 2019, 29). Methane emissions, fossil fuels, and land concerns all contribute to greenhouse gas emissions

The reliance on non-renewable fossil fuels drives a high rate of carbon emissions. 17 percent of fossil fuels in the United States goes towards food production in the form of energy creation (Horrigan, Lawrence, and Walker, 2002, p.448). Energy is also used in transportation of food products in the production, processing, and packaging to delivery of goods (448). The soil infertility mentioned above contributes to climate change by making soil degradation a source for carbon dioxide mitigation in the atmosphere ("FAO strategy on climate change", 2017, p.32). These contributions to greenhouse gas emissions produce climate change, which is the main driver of biodiversity loss (31). The loss of biodiversity affects the survival of crops and livestock genes that are essential to production systems, and as conditions change, breeds of animals and varieties of crops are abandoned and neglected by farmers (32). Greenhouse gas emissions not only affect feed crop yields and prices, but they also add to heat stress endured by livestock, especially dairy cows. There is a strong, negative correlation between productivity of dairy cows and heat stress, and the dairy sector lost 1.2 billion dollars in 2010 as a result (Cessna, J. and Law, J., 2018).

Taking Action: A Net-Zero Approach

The environmental concerns the agriculture industry brings to global health calls for action. Today, industrial agriculture is arguably the industry with the most environmental outputs associated with it, and continuing with the industry as is will

eventually result in a decrease of productivity, inability to produce, and failure to sustainably develop (Pyle, 2005, p.xiii; Sagasta, Zadeh, and Turral, 2017, p.9; Ikerd, 1993, p.151). With the significance of agriculture weighing heavily on the U.S. economy and the environmental health of the United States, a solution that allows for minimum environmental damage while maintaining the economic benefits is crucial moving forward. Policy makers and consumers are realizing that current food systems and food production methods are flawed, and these flaws are contributing to future potential crises (Roberts, 2008, p.xxiii). As a key driver of the economy, agriculture must be altered in a way that economic benefits continue but in a way that environmental damage is decreased, while assisting farmers.

Energy consumption, water usage, biodiversity loss, and carbon emissions are all environmental concerns that are being addressed in residential and office space settings through the implementation of net-zero initiatives (Kliwinski, 2016). Net-zero is an approach that creates closed-loop systems for energy/carbon, water, and waste processes by equaling out the consumption of energy/carbon, water, or waste with amounts produced by renewable sources. Utilizing the concepts and success of net-zero energy, water, carbon emissions, and waste within these other contexts may be a solution to farming controversies. Offices and homes are investing in these dilemmas through net-zero endeavors to lessen environmental impacts and save money long-term. Benefits of net-zero include energy and water security, cost savings, environmental stewardship, safety, and resiliency (Edminster, A., 2018; “LEED Zero verifies net zero goals”, 2018). Some challenges associated with net-zero building include complications with building codes, infrastructure concerns, and some public

perception (Edminster, A., 2018; “LEED Zero verifies net zero goals”, 2018). Nonetheless, the success these initiatives are currently having in businesses and residential usage encourages the expansion of these ideas to small farms to try out as a solution to current agriculture production. The triumphs of net-zero lead to the research question, “Would net-zero initiatives be a feasible option for small to medium size farms to help save money and address agriculture environmental concerns?”

What is Net-Zero?

Defining Sustainability:

To fully utilize the workings of net-zero, it is important to first build a foundation for understanding the net-zero framework by defining its core value of “sustainability”. The classic definition of sustainability stems from the Brundtland Report which states that sustainability, “meets the needs of the present without compromising the ability of future generations to meet their own needs,” (Santillo 2007, p.60). The definition varies across contexts and often is defined based on one of three focuses: economic, ecological, or social (Boogaard 2008, pp.24-25). Examples include

1) The Environmental Protection Agency’s (EPA):

> “Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations,” (EPA, 2018).

2) Greenpeace Researcher David Santillo’s:

"[Sustainability is] of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged; [sustainable techniques, sustainable agriculture] and of or relating to a lifestyle involving the use of sustainable methods," (Santillo 2007, 61-62).

3) Environmental Manager Richard Shearman's:

"The continued satisfaction of basic human needs--food, water, shelter--as well as higher level social and cultural necessities such as security, freedom, education, employment, and recreation (social impact version). Sustainability from an ecological perspective was defined as representing 'the continued productivity and and functioning of ecosystems (ecological impact version),'" (Shearman 1990, 1-2).

4) The United States Green Building Council's (USGBC):

"Sustainability means creating places that are environmentally responsible, healthful, just, equitable, and profitable," (Edminster, A., 2018; LEED, 2018).

5) Apple Inc.:

"[Sustainability to Apple is reducing] our impact on climate change by using renewable energy sources and driving energy efficiency in our products, facilities, and supply chain; [Conserving] precious resources so we all can thrive; [and pioneering] the use of safer materials in our products and processes," (Apple, Inc.).

As these definitions indicate, there is not an established definition of sustainability. Universities, businesses, countries, regions, states, and individuals, all define the word

in different ways depending on context and personal values. Society's goals now encompass more than simply the production and consumption of goods and services, and with the Western society embracing values beyond low cost, sustainability pushes to the forefront of endeavors demands a universal definition (Boogaard 2008, 25). Despite the variance in definitions, one aspect is clear: sustainability's highlighting characteristic is the emphasis on having *the ability to be continued* (Shearman 1990, 2; Santillo 2007, 61).Given these different conceptualizations of sustainability, this proposal chooses to define the term as follows:

> Sustainability: "Reducing our impact on climate change by using renewable energy sources and driving energy efficiency in our products, facilities, and supply chain; Conserving precious resources so we all can thrive; [and pioneering] the use of safer materials in our products and processes."

Defining Net-Zero:

Net-Zero is a concept that takes the idea of sustainability a step further by moving from structures taking resources from the environment to structures producing resources for their own consumption. The Environmental Protection Agency (EPA) explains the term as, "[structures] consuming only as much energy as is produced, achieving a sustainable balance between water availability and demand, and eliminating solid waste sent to landfills," (EPA, 2018). This definition is foundational for the workings of net-zero, but the United States Green Building Council (2018) takes it a step further defining net-zero as, "[structures] demonstrating any or one of the following: net-zero carbon emissions, net-zero energy use, net-zero water use, or net-zero waste,"

(Edminster, A., 2018; LEED, 2018). The fundamentals of a net-zero framework are clearly seen in the USGBC definition in three main components: net-zero energy/net-zero carbon, net-zero water, and net-zero waste.

Net-Zero Energy

Net-zero energy focuses on finding a balance between the yearly energy consumption of a structure and its systems and the amount of energy produced by the structure's renewable energy systems (Hernandez, 2009, 815). To be considered a net-zero energy structure, the overall annual energy consumption must be less than or equal to the energy produced by renewable systems (EPA, 2018; Hernandez, 2009, 817; Kolokotsa, 2011, 3067). Anything produced beyond what is consumed is considered to be net-positive energy or net-regenerative energy (EPA, 2018).

The whole objective of net-zero energy practices is minimizing the amount of energy a structure consumes in addition to designing a structure that blends energy production technologies with renewable techniques (Kolokotsa, 2011, 3068). These designs can be accomplished through systems incorporating natural heating methods (solar, geothermal, wind, or passive); improving insulation,-using innovative shading devices,- and installing "intelligent" energy management controls (e.g., advanced sensors, zone heating and cooling, monitoring systems, etc.), and other process (3068). The Living Building Challenge (LBC) created by the International Living Future Institute is the handbook net-zero builders refer, which displays how to be not only net-zero but also net-positive. The LBC states net-zero energy to be, "One hundred and five percent of [a] project's energy needs must be supplied by on-site renewable energy on a net

annual basis; without the use of on-site combustion. Projects must provide on-site energy storage for resiliency," (Kliwinski 2016). Even though net-positive energy is the ultimate goal for this business' services in the long-run, as a starter company applying an up and coming building practice, this proposal focuses on the United States Department of Energy's (U.S. DOE) (2018) conception of net-zero energy, defined as:

> "Net-zero energy is an energy efficient [structure] where on a source energy basis the actual annual delivered energy is less than or equal to the on-site renewable exported energy."

Net-Zero Water

Net-zero water is a concept along the same lines as net-zero energy, but focuses on water consumption instead of energy consumption. Net-zero water systems are designed to decrease total water usage, increase usage of alternative water sources, minimize wastewater, and maximize water returns to original origins while preserving natural waterways (Kliwinski, 2016). Minimizing depletion, deterioration, and rerouting of water creates efficient methods that lessen the demand for freshwater as a resource for structural operations and functions (US Department of Energy, 2018; EPA, 2018). Achieving these water goals arises from magnifying the use of rainwater, greywater, and blackwater as well as increasing water efficiency through plumbing fixtures, irrigation controls, and process loads.

Referring back to the reference of overarching guidelines set by the LBC, the International Living Future Institute considers net-zero water to be, "One hundred percent of [a] project's water needs [are to] be supplied by captured precipitation or

other natural closed-loop water systems, and/or by recycling used project water, and must be purified as needed without the use of chemicals," (Kliwinski, 2016). This definition, again, is a potential end goal for net-zero water, but it will not be the definition used for the proposal due to its requirement that all water has to be supplied on site. For farmers, that requirement is not realistic. Furthermore, treating water onsite can potentially cause building code problems, which farmers will want to avoid. This proposal will again be using the U.S DOE's definition for net-zero water due to its feasibility in allowing structures to connect to municipal water sources when they are low on water supplies. Net-zero water is defined as:

> "A building that is designed, constructed, or renovated and operated to greatly reduce total water consumption, use non-potable sources as much as possible, and recycle and reuse water in order to return the equivalent amount of water as was drawn from all sources, including municipal supply, without compromising groundwater and surface water quantity or quality," (Kliwinski, 2016).

Net-Zero Waste

Net-zero waste is the third component to the net-zero framework. The purpose of this portion of the framework is to reduce or eliminate waste produced on-site and, potentially, in the supply chain of projects and structures. Source reduction, elimination, recycling, and incineration are methods to achieving net-zero waste. Source reduction and elimination include cutting back on wastes by not generating waste in the first place; designing structures with net-zero systems in mind; and investing in waste stream management in current structures (Edminster, A., 2018; LEED, 2018). Recycling

is encouraged when you cannot eliminate waste completely but project participants encourage onsite source separation recycling methods or single stream recycling methods throughout the duration of projects (Edminster, A., 2018; LEED, 2018). Incineration (burning of waste on-site) is a last resort of waste eradication that ensures waste does not reach landfills (Edminster, A., 2018; LEED, 2018).

Taking these steps towards proper elimination of wastes moves projects towards net-zero waste goals. The EPA (2018) claims net-zero waste as, “reducing, reusing, and recovering waste streams to convert them to valuable resources with zero solid waste sent to landfills over the course of the year. The LBC definition differs slightly:

> “[The goal of net-zero waste is to] reduce or eliminate the production of waste during design, construction, operation, and end of life and find ways to integrate waste back into either an industrial loop or natural nutrient loop [that achieves] 90-100 percent recycling waste [rates],” (Edminister, A., 2008).

Also included as a requirement in the Living Building Challenge definition of net-zero waste is that all projects must feature at least on salvaged material per 500 square meters of gross building area or must be adaptive reuse of an existing structure (Edminster, A., 2018; LEED, 2018). Currently, only about 50 to 70 percent of waste is recycled when building structures and projects, so this additional requirement assists in increasing the use of recycled materials, thus shifting towards net-zero initiatives (Edminster, A., 2018; LEED, 2018). Since this proposal is geared toward existing farms, it will use the U.S. DOE’s net-zero waste definition instead of the EPA or LBC definitions. Net-zero will be defined as,

“A building that is operated to reduce, reuse, recycle, compost, or recover solid waste streams (with the exception of hazardous and medical waste) thereby resulting in zero waste disposal.”

Key Definitions

- **Sustainability:** The ability to use and replenish resources at a rate that does not take away from the Earth, hinder profits, nor hurt people. (change)
- **Net-Zero:** [Structures] consuming only as much energy as is produced, achieving a sustainable balance between water availability and demand, and eliminating solid waste sent to landfill.
- **Net-Zero Energy:** Net-zero energy is an energy efficient [structure] where on a source energy basis the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
- **Net-Zero Water:** Net-zero water [is] a building that is designed, constructed, or renovated and operated to greatly reduce total water consumption, use non-potable sources as much as possible, and recycle and reuse water in order to return the equivalent amount of water as was drawn from all sources, including municipal supply, without compromising groundwater and surface water quantity or quality.
- **Net-Zero Waste:** A building that is operated to reduce, reuse, recycle, compost, or recover solid waste streams (with the exception of hazardous and medical waste) thereby resulting in zero waste disposal.
- **“Small Dairy Farm”:** A farm in Tennessee having fewer than 500 cows.
- **On-Site Renewable Energy:** [The] physical installation of equipment on your project site directly connected to your building providing power (i.e. solar, wind, geothermal, fuel cells, waves)

Appendix B

Due to the fact that net-zero initiatives are still up and coming within the farming industry and exact price information varies from project to project, the pricing information will be derived from a case study. The following prices will explain net-zero energy implementations on dairy farms (since that is the starting point LDEC, LLC desired), with some of these prices coming from a case study/research project conducted by Mckenzie Dice of the University of Minnesota. Morris' research was centered around net-zero energy dairy production by powering Minnesota dairy farms with renewable energy in a study that finished in 2017. This case study example provides costs, net present value, and return on investment information for net-zero energy operations on a 250 cow dairy farm that will provide provide insight to the potential costs and savings farmers can endure through net-zero practices. The following table is a breakdown of the initiative, its cost, and its output to demonstrate the costs associated with net-zero energy.

Initiative	**Purpose**	**Size**	**Cost to Implement**	**Output**
LED Lights	To reduce light bulb replacement costs and maintenance on fixtures	Based on number of lightbulbs needed	About $5 per bulb	25,000 hours worth of light; Reduce cost to cool barn since they don't give off heat; uses about 212.5 kWh energy over "lifespan"; costs $21.25 for electricity

Solar Thermal (use of flat plate or evacuated tube system)	Collection of energy as heat; Offsets costs of heating water on the farm	Depends on project	$2,500-$7,700 (basic versus full system)	Heat creates steam that produces electricity for a generator; energy created
Solar Photovoltaic (PV)	Collection of energy as electricity; Used to connect to the grid and earn utility credits	1 50 kW panel system (in this study)	$138,000 (as used in this study)	Produces about 70,000 kWh annually; saves $7,000 annually
Wind Turbines	Offset energy needs	2 turbines producing <100 kW (in this study)	$156,800 (as used in this study)	Projected to produce 40% of the farm's energy needs; estimated 22,400 kWh per year per turbine; saves $2,240 per turbine, per year
Milk Pump Variable Frequency Drive	Reduce emissions and reduce operating costs	Depends on project	$3,000-$10,000 (depends on size)	Saved $4/day in operating costs; Reduced energy usage by 75%

eGauge	Monitor energy usage and measure energy produced; Reduces energy consumption and costs	2 eGauges installed (in this study)	$549-$899 (depends on basic or pro)	Produces minute-to-minute data of energy consumption to determine times and sources of usage; all energy efficiency upgrades for this study expected to save $11,223 per year
Aeroseal	Duct sealing method to increase energy efficiency	n/a	$1.50 per square foot (premium price)	Ranges 70-90% reduction in energy costs
Water Meters	Tracts water usage to determine high and low areas of consumption	Install at least 2	$300-$600 per meter	Installing two gauges allows farmers to track irrigation or other water uses that don't count towards sewage expenses
Triple Glazed Windows	Keep cool/hot air inside, reducing energy costs	Depends on number of openings	$600-$1,100	Make house quieter, more energy efficient, and warmer/cooler
Water Catchment Systems	Capture rainwater and greywater for reuse	Depends on size of farm/number of barrels needed	$1,500-$15,000 (house size system versus industrial system)	Cut water costs by utilizing water in multiple ways across a farm and offsetting potable water costs

The next table depicts the costs of implementation, the total cost of the systems, the net present value (NPV), and the internal rate of return (IRR).

Initial Costs of Systems	**Cost to Implement**	**REAP Grant**	**Federal Tax Credit (30%)**	**Cost of System with Incentives**	**NPV**	**IRR**
Energy Efficiency Upgrades	$229,670	-$57,418	-$68,902	**$103,350**	**-$94,702**	**-6%**
50 kW Solar	$138,000	-$34,500	-$41,400	**$62,100**	**-$30,044**	**8%**
Two 10 kW Wind Turbines	$156,800	-$39,200	-$47,040	**$70,560**	**-$55,359**	**-3%**
Totals	*$524,470*	*-$131,118*	*-$157,342*	***$236,010***	***NPV shows the farm is still paying back money for the initial costs***	

Appendix C

Green certification possibilities as a bonus from implementing net-zero initiatives:

- LEED
- Safer Choice
- Green C Certification
- EnergyStar
- EDGE
- Fair Trade USA Certified
- PEER
- Green Seal
- WasteWise
- WaterSense
- Green America